OPINION MINING ON SENTIMENT ANALYSIS : A COMPREHENSIVE MIRROR REFLECTION ON PEOPLE THOUGHTS

VEDANTHARAJAGOPAL.S
Assistant Professor
RamakrishnaMission Vivekananda
College(Autonomous) Chennai

Dr.BABU.S
Assistant Professor
Department of CSA
Sri Chandrasekharendra Saraswathi Viswa
Mahavidyalaya University

Abstract: During an affective decission making it has been an important point of curiosity to know the thoughts of others.Decisions made by either an individual or at organization levels are always accomplished by opinion of others' for the same. Opinions and sentiments can be studied and constructed well with the help of high-quality opinion mining and sentiment analysis formulation. A rich compendium of sentiments can be obtained through exponential grown opinion resources such as discussion forums, public reviews, micro to macro blogs, Facebook, WhatsApp, Telegram, Twitter, LinkedIn and many more. Sharing opinion in public became a craze among today's generation. For an enhancement of services and products such feedbacks become crucial either for an individual or for organizations. Opinion mining helps in analyzing these huge collected reviews. In order to make the reviews easily understood by the users, these collected reviews are distinguished upon the emotions which are being expressed by the users, classification between them into negative and positive are carried out. Opinion mining is the most buzzed technical word in the trending technology which is attracting many researchers in order to solve the challenges which are being faced in it. In order to trace out the best in an item in terms of feature and quality can by achieve by effective sentiment tools and opinion mining. In this research paper a complete overview of opinion mining in sentiment analysis has been carried out along with the comparative approaches usingrecent methodologies, certain challenges which need to be addressed in this regard are also highlighted.

I.   INTRODUCTION

Sentiment analysis is also referred as opinion mining, it is field where study to analyze sentiments, apprisals, evaluations, opinions of people, emotions and attitudes towards various things such as services, organization, products, individuals , events, issues, topics and their related attributes. This filed has much space for research to be carried out. Many names and tasks e.g., Opinion extraction, opinion mining, Sentiment analysis, sentiment mining, affect analysis, subjective analysis, review mining, emotion analysis, and many more. All these now come under a single umbrella which is referred as opinion mining or sentiment analysis. On academic side both opinion mining and sentiment analysis are frequently employed. On industrial side the most commonly used field is sentiment analysis.Social media explosion has created a tremendous platform for citizens which provide opportunities in an unprecedented manner to publicly share their voice, due to this viral kind of nature exhibited by social media some issues though not important unpredictably and rapidly turns to be important by word-of-mouth. While making sense with these from their collected opinions creates bottlenecks which are serious. Citizens concern towards achieving real time scenario understanding has grown. Day-by-day communication among people is becoming more convinient with much advent in technology. Internet became a major source whose percentage in such kind of communication is very high. This huge collected data now resembels a gold mine from which information which is hidden may discovered succesfully. From computer science point of view both sentiment analysis and opinion mining are oftenly interchangable.During the construction of judgement views play a crucial role Opinion mining is considered as the approximated estimation what a user belief sentiments and evaluations about actions units along with their features For Decision making whether related to an organization or individual with different nature has data abstraction as important characteristic Data mining and opinion mining have several features in common During the selection or purchase of a product individual may benefit if he takes other views about the product before user buys it. It is very difficult to find out a place thing or an item on which there might be no opinion whether that is either good or bad positive or negative impressive or depressive worth full or penniless a large volume of rich content generated by user are available in the form of major social network sites, e-commerce site. With the advent of web 2 0 such huge collected information from social networks are easily accessible while information insight extraction manually is impossible. Customers sharing the thoughts on the public platforms are more prevalent to service industry and business.

A decision taken or given without consulting others or giving importance to others opinion has to be considered as in effective beside these opinions are key factor in order to make a complete conclusion or decision. In general opinions fall under category of subjective statements rather than objective statements. One can also define opinion as a judgement or belief which is a small form of absolute conviction, positive knowledge or certainty.For a given context uncovered human emotion can be conveyed in the outline of sentiment analysis. When SA expressed in different aspects one can easily predict the attitude, emotions and person's personality. The hidden emotion of human for a context is identified by SA, thereby making the machine to know accurately these emotions. As opinions now days are shared in public, initially the same was done with family members, relatives, friends and neighbors etc., in person.

There are many definitions of opinion, it is defined as a quadruple consisting of ($g,\ s,\ h,\ t$) where they represent *opinion, target, opinion holder, time*. It may also be referred as quintuple ($e_i,\ a_{ij},\ s_{ijkl},\ h_k, t_l$) which are represented as *entity, aspect, sentiment, opinion holder, time*. Opinion may be given of the followingtypes either direct or indirect, implicit or explicit,

Direct opinion: Expressed directly on entity or aspect of entity. e.g., "*The book is written good*"

*Indirect opinion:*Expressed in indirect manner on entity or aspect of entity. e.g., " *After taking medicine my joints started pain* "

Implicit opinion: Gives a subjective statement either in regular or comparative manner. e.g., " *Benz is better than Ferrari* "

*Explicit opinion:*Gives an objective statement which implies a regular or comparative opinion. e.g., " *Mi phone battery life is longer than other phones* "

Opinion Representation

Using the following two kinds of representation opinions are expressed.

Basic Representation: .Its three components are expressed as

Opinion Content: Expressions embedded in the statement.

Opinion Holder: One who expresses freely his thoughts and views on something including events, organizatons, place , product, persons.

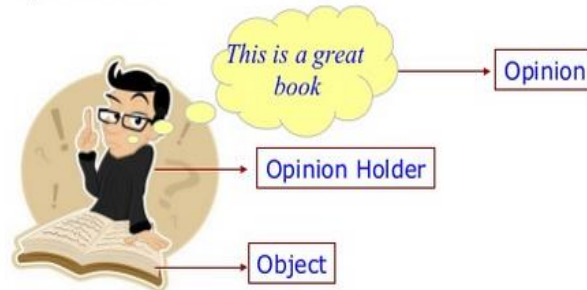*Opinion Target:* The entity on which opinions are expressed.

Fig 1: Pictorial representation of opinon related terms

Detailed Representation: A better way representation of a under considered statement for getting a best and detailed termination. A statment which is under considertion which can expressed in a better way. Its two included parameters areOpinion context: The circumstances under which opinion is being expressed.Opinion Sentiment: Feeling on an opinion holder is expressed in his opinion, this may include his dissatifaction or satifcation, personal comments which might be either negative or positive.
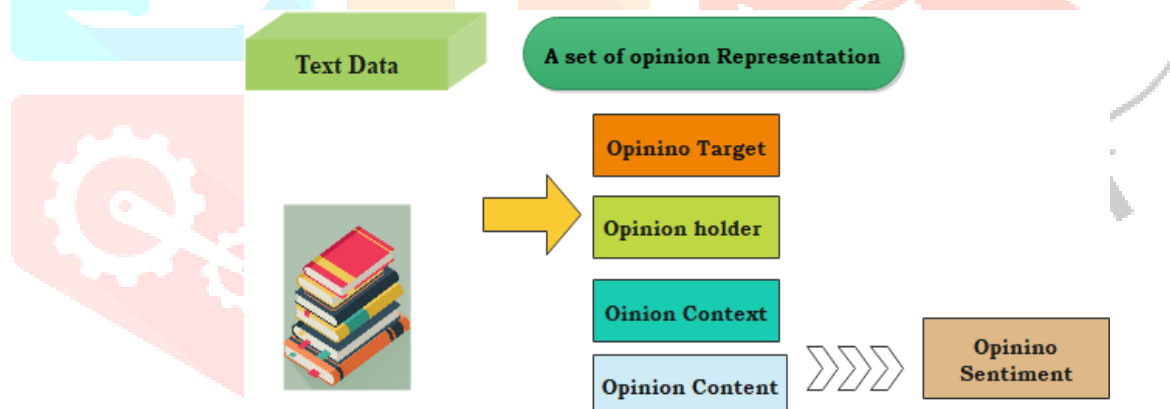

Fig 2 : Task of opinion mining

II.   SENTIMENT ANALYSIS CLASSIFICATION TECHNIQUES

The following techniques are used for the classification of sentiment analysis. The main classification is carried out into two types. One classification is based on machine learning approach and another on lexicon based approach, where machine learning is further sub classified into supervised and unsupervised learning. Here Lexicon base approach is again sub classified into dictionary based and corpus based approaches. These subclassifications are futher classified into various other classifiers under different categories which are decission tree, linear, rule base and probabilistic classfiers. Where as corpus based approach is classfied into statistcial and semantic. Linear and probabilistic classifiers are further divided into SVM,NN,NB classifer , BN and maximum entropy.
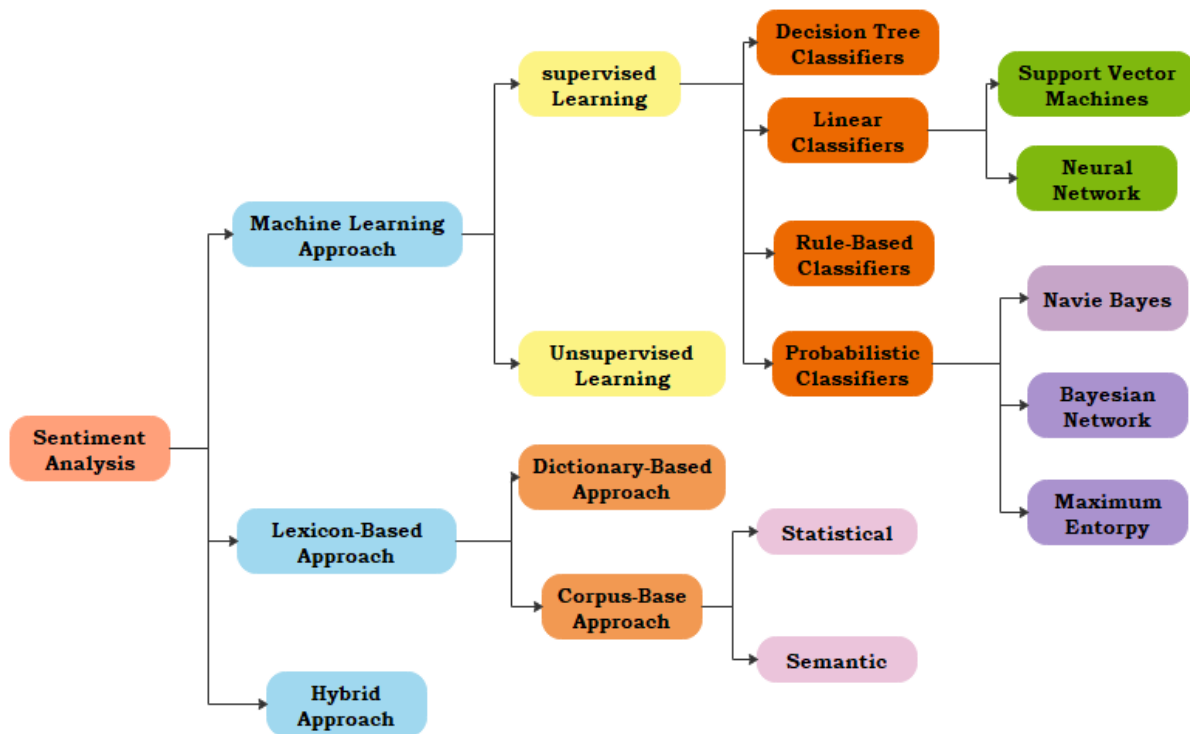
Fig 3: Sentiment Analysis Classifiers

Classification through Machine Learning

For a given system to optimize its performance linguistic featured ML algorithms are used. For ML dependent classification training and testing sets are required. For learning the characterstics of the document training set classifiers are helpful , where as testting set classifiers are used for the validation. ML based text classification are categorized into two learning method types as supervised and unsupervised. Some of the popular ML based techniques used for text classification are NB, ME, SVM. Other are included as K-NN, C5,ID3, N-gram model, centroid and winnow classifer.

Supervised learning: Uses labelled trained documents. There constrains include language dependent and domain specific. In sentiment analysis some of the key features of supervised learning are sentiment words and phrases, parts of speech, rules of opinion, syntactic dependency, sentiment shifters. They are again classifed into the following type [1].

   *Decision Tree Classifer:*For a given dataset which is classified using decision tree the node resemble features and edges resembe as trail. given document for sentiment analysis is categories intiating from root of the tree moving down until leaf node is encountered.Its advantage covers that it required minimal data for preparation, easy to implmention and interpretation. Large input given can be computed authoritatively with in finite time. Its drawback is that for some analyis a complicated tree is generated with is difficult to be generalized after [2].

   Linear Classifier: In order to get a clear classification among various classes this classifier is best to be used. Margins in linear decisions are used for classification of input cectors into classes. This kind of classifiers include SVM and NN [3].

*Support vector machines:*Dealing with the problem of speech classification SVM is considered as the best fit among the existing one which provides the results with high accuracy. This can be achieved by including maximal Euclidean distance in the created hyper plane on the near trained examples. By considering the subset of trained dataset the problem SVM hyper plane is resolved, there by the qualified classifiers have no access to the left trained dataset [4]. As labeled trained datasets are not required for classifying text and hypertext so SVM can be used in this context.

*Neural networks:*Neurons are the basic functional units of neural networks. For classifications done using margins with non-linear functions MNN are mostly preferred. As there are number of layers in these kinds of networks so the output of one layer is considered as the input of another. Training the network with a given dataset is a challenge, because there is

more scope for errors to rise which may then be propagated back again to the starting layers hence the process continues [5].

Rule-Based Classifier: Following a group of rules dataset is designed as the name of the classifier itself suggest its nature. Here right and left side of the rules have their own meaning stating that class label represented by right where as aspects condition is indicated by the left [6].

Probabilistic Classifier: They are also referred as generative classifiers. Numerous categorization are used in this kind of classifiers, a mixture of classifiers consists of each class is formed. This model works by inspecting each word of element deeply. Maximum Entropy, BN, NB are some of the popular classifiers under this category [7]..

*Naive Bayes Classifier:*It is one of the frequently used techniques under supervised learning; reason behind frequent use is that they consume less computing power during the categorization under sentiment [8]. Due to independent nature of contingency it acquires the name naïve. The only drawback which is observed under this category is assumptions which are independent may lead to inappropriate results.

*Bayesian Network:*In order to overcome the drawbacks which were caused by not giving importance to aspects of dataset in Naïve Bayes has been overcome in Bayesian networks. They represent the graph which is non-cyclic in nature having nodes and edges where nodes correspond to variables and edges correspond to conditional independency [9].. Its drawback is due to expensive in nature it is not implemented for text classification.

*Maximum Entropy:*Among many NLP tasks ME is used for distribution of probability estimation technique, and this distribution during absence of pre-knowledge should be uniform. Neglecting unwarranted assumption model is built with the help of which frequencies of joint-feature individual in nature are captured [10].

Unsupervised learning: When availalabity of trained labelled documents are difficult this approach is used. As robust solutions are required for pulically avaiable data which is unlablelled so this approach is much in demand. Here classification of text is done by comparing it either with sentiment lexicon or word lexicon, whose values are found before carring out sentiment analysis. Feeling of people, their expressed views and opinions when collected and expressed together are defined as sentiment lexicons .The given document is scanned for the presence of these lexicons depending on their type they are classified as either negative or postive [11].

SO for phrases which are extracted are given and PMI

PMI (term$_1$, term$_2$) = log$_2$ (Pr(term$_1 \wedge$ term$_2$) / Pr(term$_1$)Pr(term$_2$))

$$PMI(term_1, term_2) = log_2 \left(\frac{Pr((term_1 \wedge term_2)}{Pr(term_1) \, Pr(term_2)}\right)$$

Where

Pr (term$_1 \wedge$ term$_2$) is actual probability co-occurance of term$_1$ and term$_2$.

Pr(term$_1$), Pr(term$_2$) is probaility occurance of term$_1$ and term$_2$ independently.

SO can be computed for a given phrase depending on whether it is postive or negative with respect to the refernce words such as "excellent " and " poor".

$$SO(Phrase) = PMI(phrase, \text{"excellent"}) - PMI(phrase, \text{"poor"})$$

Classification based on Lexicon approach: For a given textual content its polarity in terms of either neutral, positive or negative is described effectively with the help of a sentiment lexicon. This approach is easily implemented and understood well when applied with ML algorithms. More the size of the information given as input, the more easily the test can be done in order to identify different sentiments across given source of content [12]. This approach can be further classified into two categories based on dictionary and corpus approach, where the second is based on the words in dictionary and the next deal with corpus data which can be further distinguished into semantic and statistical approaches.

*Dictionary based approach:*When a new word is found manually they are collected. A list consisting of antonyms and synonyms of the collected word are created. This created list is then matched with other words to find any similar content when they are found they are then grouped together [13].

*Corpus based approach:*Its main purpose is to address languages which are used. From corpora these corpus data are being collected, they exist in two approaches as semantic and statistical. On a particular selected topic this approach is applied [14] [15].

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*Statistical:*Negative and positive words extremity determination is the principal goal for this approach. Words occurrence in a given context can be found. When negative data is high then entire data are negative and vice versa for positive data. Polarity determination whether words are positive or negative is referred as cosine similarity. For a given context where opinion is uncovered with the help of cosine similarity there by tracing similarity among two vector which comes out to be zero [16].

*Semantic:*They are considered to be great asset to NLP, for a given application they are hand coded. WordNet Cyc, are some of the common semantic knowledge bases which are generally available. For a particular topic whose sentiment analysis has to be carried out need lexicons which should be domain specific [17].

Hybrid approach of classification: As the name suggest it s a combination of both machine learning and lexicon based approaches. When the classification become complex and not solved by using either ML or lexicon then one can chose to go with hybrid.
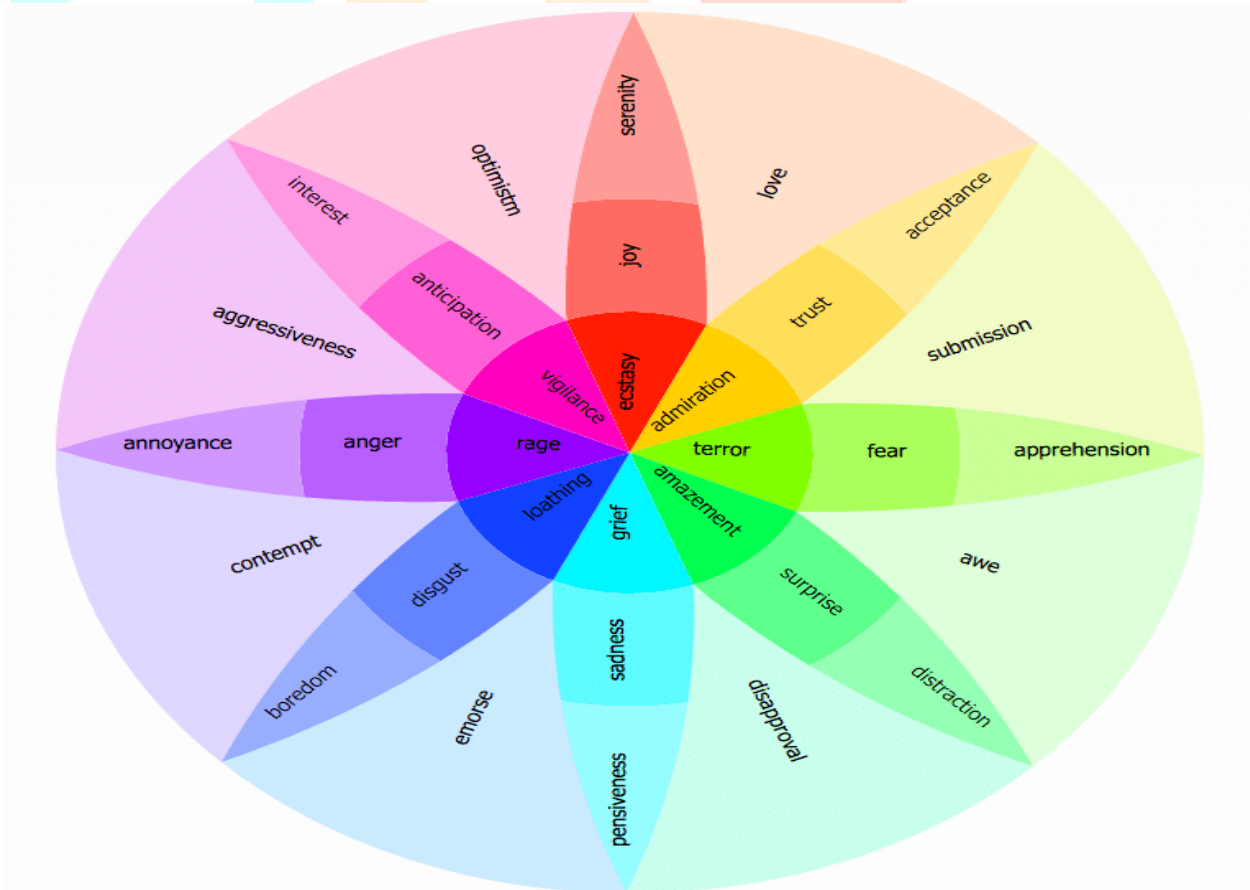

Fig: Wheel of Emotions

Various emotions which are connected with human feelings are shown in the above figure which represents various emotions and their forms which are related to one another.

Approach type	Related methods	Merits	Demerits
Machine Learning	Supervised, Unsupervised	For a selected model effective training is given.	More costly and applicable only for labeled data.
Lexicon Based	Dictionary Based , Corpus Based	High accuracy , high extensive term analysis	Carried out on limited number of words.
Hybrid	Combination of both ML and Lexicon Based	Carried out at sentence level easy for document level	Complex and noisy

Table 1: Showing the comparative approaches of sentiment analysis technique

III.   DIFFERENT LEVELS OF ANALYSIS

Classification of different levels of analysis is shown in the below figure where the three major categories are document level, feature level and sentence level.

Document level: For a given document it is analyzed whether the opinion comes out to be either negative or positive sentiment, here single entity analysis is carried out. For example, when a product review is given for analysis it is tried to found that whether the overall opinion lies either towards positive or negative, Thus, at this level it is not possible to make comparison of multiple level entities [18].

Sentence level: Here the task is carried out with respect to sentence level. It is determined whether a expressed sentence is having neutral, positive or negative opinion. This analysis resembles subjective classification which distinguishes objective and subjective sentences. Where factual information is expressed by objective sentence and views and opinion are expressed in subjective sentences. The important point to note here is that subjective does not imply sentiment but whereas objective gives a opinion view [19].

Feature level: When both the above two levels fail to determine what are the likes and dislikes of people,feature level analysis is carried out with two sub levels as entity level and aspect level. In this level summarization and OM with respect to feature are carried out. Here language (*clauses, documents, sentences or phrases*) are not given importance. Opinion itself is given importance at aspect level with works on the principle that sentiment (*negative or positive*) is embedded in opinion (*target*). A target less opinion is used limitedly, from this importance of opinion target comes out stating their role in analysis of sentiment [20].Depending on situation and required kind of sentiment output remaining kind of implicit level of analysis are used which may cover fuzzy rule, association rule, rule based, co-occurrence, topic modeling and many more. It plays a key role for the selection of the kind of level that is applied to get the desired sentiment output.
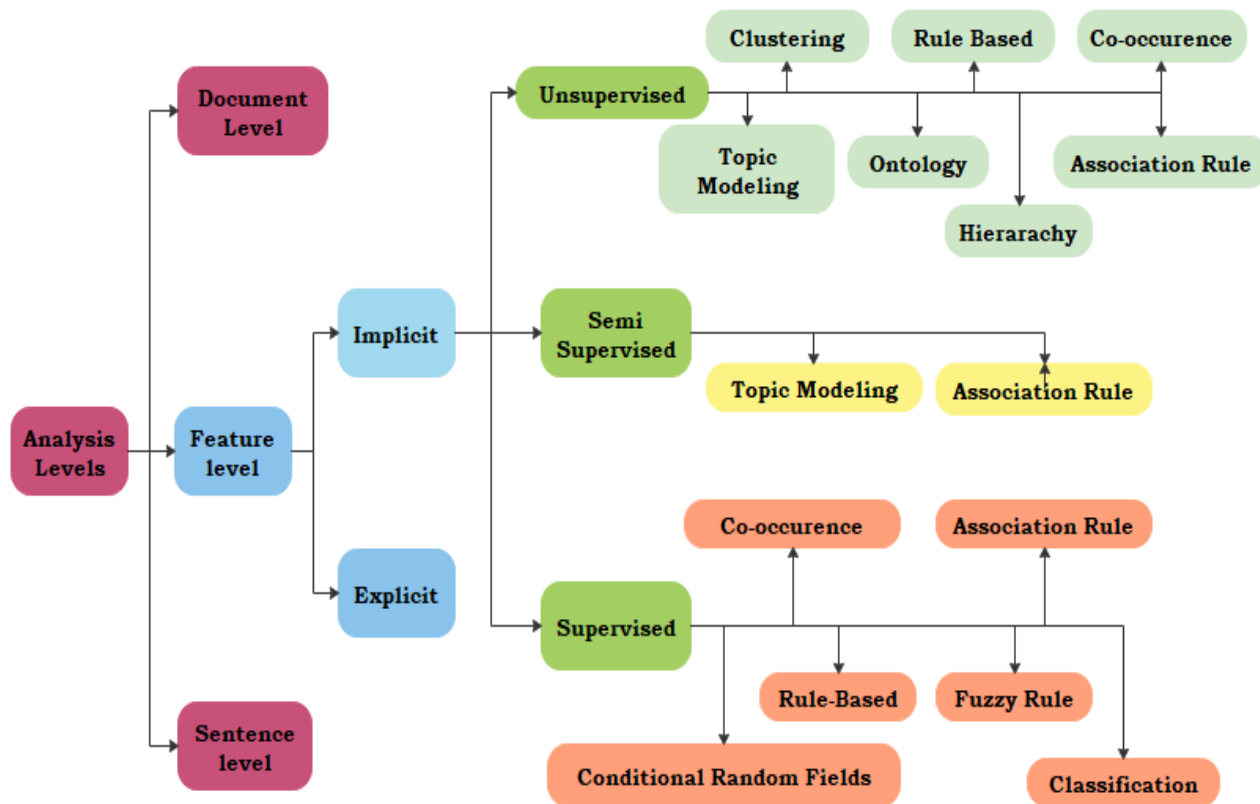
Fig: Showing the levels of analysis

Author	Methodology	Contribution	Data set used	Outcome	Limit
Chen tao et al. [21].	BiLSTM-CRF and CNN	Sentiment analysis is performed on each type of the sentence which is classified into different types. For more complex sentences CNN model is applied.	MPQA (Multi Perspective Question Answering)	Gives state of art results with respected to four considered dataset due to which sentence – level sentiment analysis is boosted.	Not applicable to Expression detection
J.Xu et al. [22].	Attention-based Heterogeneous Relational Model (AHRM)	For a given social information sentiment analysis having multi model can be improved using AHRM	Flickr dataset and Getty Image dataset	For a given image and text correlations with emotional nature are enhanced	Limited on text and images with fine grained co-relations.
Kanda swamy et al. [23].	Multi- Refined neutrosophic sets (MRNS)	MRNS having two positive, two negative and three indeterminate memberships are proposed which are helpful for sentiment analysis of twitter data carried out successfully.	Twitter	For a given twitter content neutrality and indeterminacy are achieved successfully	Up to only 1000 tweets analysis can be carried out for more it takes a bit time.
Meskele, et al.[24]	A Lexicalized Domain Ontology and a Regularized Neural Attention Model (ALDONAr)	Sentences with complex structure can be handled with a well designedclassification module With respect to aspect based sentiment values in a sentence which are being influenced by each word can be measure with a context attention	Restaurant and Hotels Dataset	Sentiments based classification on aspect at sentence level is obtained successfully.	Limited to aspect polarity and not applicable for implicit aspects.

		mechanism having a bidirectional nature			
NC L e et al.[25]	BERT, A Transfer Learning Method	In TL while dealing with a given problem the generated knowledge is stored in order to solve same kind of problem in future.	VLSP dataset (Vietnamese Language and Speech Processing)	High accuracy results consisting of aspect polarity and aspect detection were obtained from Vietnamese dataset	For same kind of problems only this method is applicable one cannot apply this method for different kind of problems.
Wang et al.[26]	Deep Learning Model	Foreign and domestic audience preference with respect to cultural characteristics and movie were traced out using a fusion model created b y the combination of RNN and CNN.	Large Movie Review Dataset	simple neural network can achieve higher accuracy on the text classification problem	High Computing during the process failed to be achieved, accuracy of results has to be enhanced further
Wei et al.[27]	BiLSTM model for implicit sentiment analysis	Helpful for modeling the differences with respect weights, attentions among polarities, no sentimental explicit words, and obscure in nature.	SMP2019-ECISA dataset	Compared to Chinese implicit SA evaluation. The obtained results are 2.1% improved.	Do not support knowledge base, semantic inference based mechanism for implicit sentiment identification.
Y Zhang et al.[28].	Three way Enhanced CNN (3W-CNN)	Considering 3W-CNN ensemble method used with ensemble model for finding the performance with NB-CNN model with respect to accuracy improvement for sentiment classification.	MR (Movie Review), CR (Customer Reviews) SUBJ (Subjectivity) MPQP	Improving accuracy of sentiment classification	Using this model comparisons are limited to only two models, we cannot make comparisons more than two models.
Yao et al.[29].	Domain specific sentiment analysis approach specifically for hurricanes (DSSA-H)	For a build in environment systems and data-rich human an adaptive and intelligence disaster information system is developed.	Social Media Dataset (Twitter, Facebook)	Helping stakeholders including first responders such as local government, emergency officials, and insurance companies.	Limited to natural disasters cannot be extended to wildfires, infectious outbreak diseases more effectively.
Zeng Biqinget al.[30].	Multi feature interactive Fusion Model	To know the relationship existing between different granularities fusion features at with respect to three levels which are different such as characters words and sentences are considered .	Restaurant Laptop Twitter	Classification features are enhanced using strategy of feature interaction and also attention mechanism.	Limited to fusion weight of features

Table 2:Showing the approaches of sentiment analysis using different methods with limitations

The above table shows a recent research papers comparative approach of various implemented methods which were used for sentiment analysis on different kinds of datasets. Each proposed method carried out the task on the relevant dataset with the prescribed methodology, thereby getting satisfactory results with required accuracy and with relevant outcome. Though the obtained results were up to the mark which were specified during the problems statements but every method is having certain limitations. These limitations there by create space and scope for further research which has to be carried out in order to enhance

of the obtained results by overcoming the existing constraints. So, all information related to one paper in each row of above table can be taken as a one problem statement which needs to be solved.

IV. CONCLUSION

Though much work has been carried out in these areas, the efficiency of opinion mining systems has not reached to its satisfactory levels because still there are many issues which need an immediate attention. The survey paper has covered all the recent contribution related to sentiment analysis between 2018-2020. Refinements of a product, service, quality, judgement are some among many areas where opinion mining has to be carried out with proper analysis of sentiments. With advent to latest technologies and free availability of public platforms has given a scope for much data with sizes of tera to petabytes need to be analyzed properly to extract the correct opinion. Classifying them with negative or positive opinions, and summarizing them in a form which can be understood easily by the user. Once correct opinion has reached then refinements with respect to the entity can be achieved. Many limitations for various proposed models create interference during analysis process, this makes a sense of research scope where researchers are having freedom to carry out newly proposed methods in order to tune more accuracy in results.Researchers work with a motto for distinguishing various emotions which are expressed during the reviews can find much scope to take their work forward in the area of opinion mining.

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